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Gentrification through the sale of rental housing? Evidence from Amsterdam

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SUMMARY

This paper analyzes the impact of the sale of rental housing in Amsterdam on the local housing market. This increases the supply of owner-occupied housing, but can also contribute to gentrification associated with the inflow of different household groups. Earlier literature focused on the former effect and reported a negative price effect. We take a fresh look at the issue by considering the sale of private as well as social rental housing, allow for differing time trends within the municipality, controlling for area fixed effects, distinguishing between short and long-term impacts and addressing endogeneity of the sale of rental housing. The main finding is a robust gentrifying effect of the sale of private rental housing in the core area of Amsterdam.

1. Introduction

Housing markets differ widely among countries. The Netherlands is unique for its large share of social housing and the associated system of rent control that covers the large majority of rental housing. The system links the maximum allowed rent to the quality of the house as indicated by its structural characteristics such as floor space or number of rooms but for a long time did not take into account location at all. Although recent measures have allowed a limited impact of this variable, social housing still has essentially the same rent, conditional on structural characteristics, everywhere in the country.

The prices of Dutch owner-occupied houses are determined by market forces, and are considerably higher[1] in the densely populated western part of the country, particularly so in the larger cities making social housing especially attractive in those places. Considerable excess demand is the obvious consequence.

Due to the rent control, construction of rental housing of modest quality was unprofitable in the Netherlands under market conditions. Between 1945 and 1990 the government therefore subsidized its construction. The subsidy covered the gap between the present value of the net revenues and construction costs. The national government set annual targets for housing construction and was actively involved in realizing them. Social rental housing in the Netherlands is owned by housing associations. These are non-profit organizations most of them originating from the 19-th and early 20-th century to promote the construction of social housing for their members through savings, loans and subsidies.[2] Housing policy after World War II (WWII) allowed them to realize their goals and to become owners of a large share of the Dutch housing stock.

In the two largest Dutch cities, Amsterdam and Rotterdam, social democrats were the dominant political party throughout the 20th century and they focused attention on the construction of social housing. 70% or more of the new housing in these cities was of the social rental type. A large fraction of the older rental housing stock in these large cities was private property. Most of it was also covered by rent control since the beginning of World War II.

By the end of the 1980 s, it became clear that the need for more social housing was limited. Many Dutch households preferred owner-occupation and were able to pay for it. The existing stock of low quality rent controlled housing was sufficient for the lower income households that, presumably, were in need of assistance for housing. Moreover, it became apparent that the housing associations, who owned the social rental housing that had been constructed with the help of subsidies, had been able to accumulate a significant amount of equity, due to what in hindsight seemed a conservative estimate of the net revenues associated with such housing. It was therefore decided to abandon the generic subsidies for the construction of social housing, and provide more opportunities for owner-occupied housing in the national housing construction programs.

This turning of the tide occurred when it also became clear that the

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[1] The difference in the price of owner occupied housing between peripheral and core areas is at least a factor 3. See Groot, Marlet, Teulings, & Vermeulen(2015).
[2] Beekers (2012).

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departure of high-income households out of the large cities, to 'growth centers' and rural municipalities where owner-occupied housing was available and relatively cheap had devastating consequences for the big cities. The new spatial planning policy focused on housing construction close to the existing large cities (the so-called Vinex areas) and there around 70% of the new houses became owner-occupied. On top of this, the government realized an active urban renewal program that increased the average quality of housing and amenities in the big cities.

The new housing policy was successful. The market for owner-occupied housing started an extended boom period that continued until 2007. The sale of social housing to private households was made possible on a limited scale. Moreover, the increasing house prices stimulated the sale of older, privately owned, rent-controlled housing. The resulting decrease in the share of rental housing in the older parts of the big cities played an important role in the Dutch variant of 'gentrification.' This term refers to the inflow of young and often well-educated households to inner-city neighborhoods that used to be inhabited by older and low income households.

The return of interest in urban living among high-educated young workers is a worldwide phenomenon that has been referred to as 'the great inversion' by Ehrenhalt (2013). Early signs of this phenomenon in European cities were reported in Cheshire (1995). A decade later it was clear that resurgent cities were a robust worldwide phenomenon, although much of the evidence still originated from Europe, see for instance the special issue of *Urban Studies* introduced by Cheshire (2006). Baum-Snow and Hartley (2016) and Couture and Handbury (2016) have recently provided extensive documentation of it for U.S. cities. An interesting and important aspect of the popularity of central city neighborhoods among such households is the impact their presence has on the attractiveness of these neighborhoods. That is, high income households flow into older neighborhoods because they like them, but by doing so they change their demographic composition. This may further reinforce the attractiveness of the neighborhood. The phenomenon may simply work because of the fact that households like to interact with other households that are similar, a phenomenon referred to by sociologists as homophily: "similarity breeds connection", see Mcpherson et al. (2001). For instance, Bayer et al. (2007) provide a striking illustration of the importance of this self-segregating force for household location decisions. Alternatively, the presence of more high income households may have a positive impact on neighborhood amenities like the outward appearance of houses, the presence of shops, cafés and restaurants, *et cetera*.

Gentrification is likely to have consequences for house prices in the neighborhoods concerned as the incoming households have to overbid others interested in living in these areas. Indeed, Guerrieri et al. (2013) document the close relationship between gentrification and house price growth. The price effect consists of two components: the newcomers overbid the existing households and after they have settled, the neighborhood may become more attractive due to their presence, which provides an additional increase in demand and, hence, a further increase in house prices.

The emergence of interest in a particular neighborhood by high income households that formerly lived elsewhere implies an increase in local demand for housing, which tends to drive up prices. The presence of good substitute housing elsewhere in the city for the original inhabitants may mitigate its impact on actual price change.[3] The 'social interaction' effect, that comes on top of it, works through the changing demographic composition of the neighborhood. In general, the two effects are hard to disentangle without an elaborate model of residential sorting that allows for the study of residential mobility and the role of neighborhood demographics. For instance, Guerrieri et al. (2013) are unable to distinguish the two components.

Autor et al. (2014) recently studied the impact of the end of rent control in Cambridge (Massachusetts) and found a large impact on local house prices. Interestingly, they found that the value of houses that had never been rent-controlled also increased after its ending. This suggests that the neighborhoods became more attractive after new residents – paying the higher, no longer controlled, rents - had moved in. The similarity with the situation in the Netherlands is noteworthy: the formerly rent-controlled housing in Cambridge increased the supply of housing for high income households since the low income households who couldn't afford the higher rents moved out. However, the change in the demographic composition of the inhabitants apparently had a positive impact on neighborhood quality.

In this paper we consider the impact of the sale of rent-controlled housing in Amsterdam. This can be interpreted as the end of rent-control for part of the housing stock. It seems reasonable to expect that in this city the same forces are at work as in Cambridge (Ma). However, their relative importance is not necessarily the same. We noticed already that throughout the Netherlands and in particular in big cities like Amsterdam, the share of rent-controlled housing in the total stock was very large – it was in fact the majority. It seems likely therefore that the average inhabitant of this type of housing was closer to the average Dutch household than the average inhabitant of rent controlled housing in Massachusetts was to the average Boston metro area household. Moreover, tenants could obtain the social houses that were for sale at a discount. This suggests that the change in demographic composition following the sale of social housing in Amsterdam could be less significant than that studied by Autor et al. (2014) and that their findings were determined partly by the local conditions of their study area.

The paper unfolds as follows. In the next section we provide more information about the Amsterdam housing market in the past three decades. Section 3 provides further information about the data. Section 4 presents the econometric analysis. Section 5 concludes.

2. The Amsterdam housing market and the data

2.1. Introduction

The city of Amsterdam is located in the western part of the Netherlands. Its name refers to a dam on the Amstel river constructed in the middle ages, and the Dam square is in fact still the center of the city. Amsterdam experienced a 'golden age' in the 17th century and many buildings in the area referred to as the center in the map in Fig. 1 still date back to that period. The other areas indicated on that map (in Dutch known as 'Stadsdelen') were built up in later times. The ring immediately surrounding the center, the areas North, East, South and West, largely in the 19th and early 20th century and New West and Southeast after WW II.

The housing stock in Amsterdam reflects history. The canal belt is world-famous and most of its houses, many of them constructed by rich merchants, are owner-occupied. In the 19-th century extensions of the city private rental housing was dominant except in the South where higher income people located close to the Rijksmuseum and the concert hall. In the course of the 20th century social rental housing, owned by housing associations, became dominant, especially in the period 1950–1990. Since then owner-occupied housing has become more important in new construction.

Like for so many other cities, the 1970 s and 1980 s were a difficult time for Amsterdam. Many younger and high income households preferred owner-occupied housing and suburban living environments.[4] This left the city to older and low-income households and students.

However, the revival of interest in urban living in more recent decades caused a remarkable revival of the city, which was helped by

[3] Compare, for instance, the discussion in Bayer et al.(2007) on the impact of preference for the presence of similar households on local house prices.

[4] The population of Amsterdam decreased between 1960 and 1985. See https://www.ois.amsterdam.nl/visualisatie/bevolking.html.

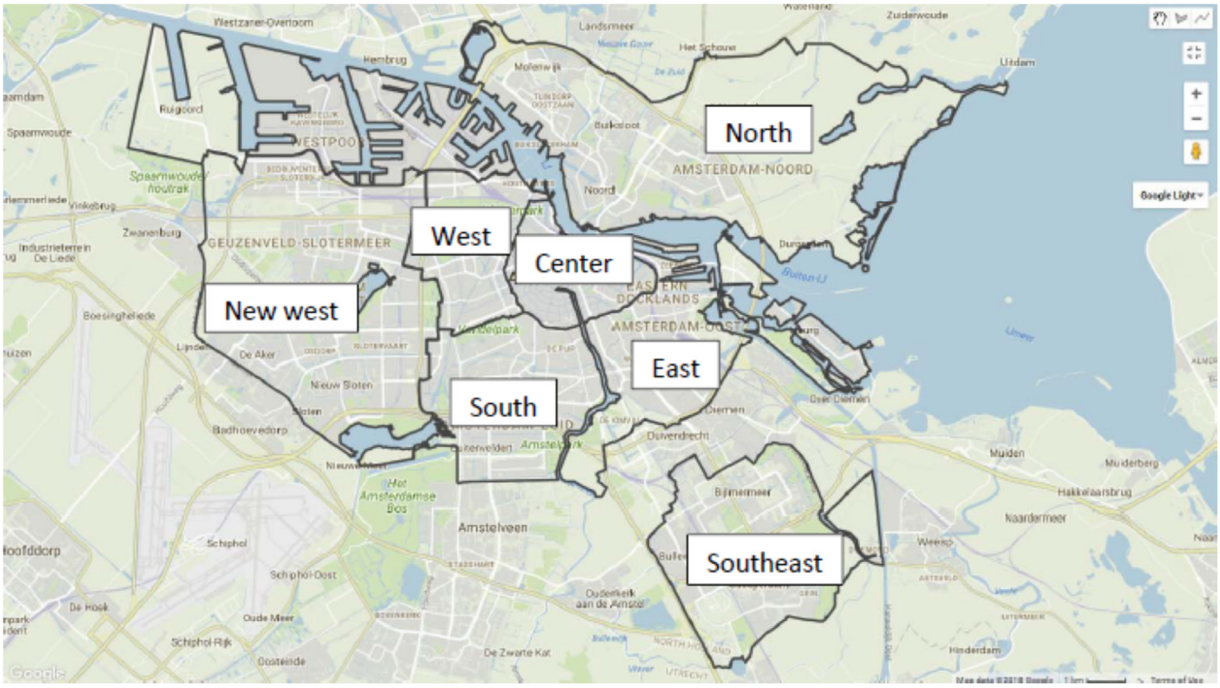

Fig. 1. The municipality of Amsterdam and the seven main areas ('stadsdelen'). *Source:* based on https://maps.amsterdam.nl/gebiedsindeling/?LANG=nl.

massive investment in the quality of housing and public space, including the restoration of many old buildings.[5] The return to the city of higher income groups was facilitated by the growing stock of owner-occupied housing. In the course of the 1990 s the Dutch economy was thriving and this was especially true for the cities. Amsterdam became the focal point of economic activity. This lead to strong local demand for housing and increasing prices. In this section we document some of the developments focusing on the Amsterdam housing market using the data that will later also be employed in the regression analyses. We will therefor first provide some information about these data.

2.2. The data

We use two main databases. The first contains information about housing transactions collected by the Dutch Association of Real Estate Agents (NVM, 2016) that covers the period 1995–2015. During this period, NVM registered 141,026 transactions within the municipality of Amsterdam. After the necessary data preparation steps (i.e. removing observations with missing or inaccurate price information, missing house type indications et cetera) 72,178 observations are left for analysis.[6] One of the main merits of the NVM data is the rich set of housing characteristics. Table A1 in the appendix shows the descriptive statistics of all variables.

We combine this information with a second database obtained from the municipality of Amsterdam (OIS, 2017) on the total number of houses and the shares of owner-occupied, private rental and social rental housing for the years 1995–2015. This data is available on a sub-neighbourhood-level (in Dutch 'Buurten'), which we refer to as wards. There are 476 wards[7] but in our analyses we only use the 203 that have non-negligible shares of both owner-occupied and rental housing. The size of these wards is much smaller than that of the 4-position postal code areas that are often used in analyses of the Amsterdam housing market.[8] A special feature of the wards is that they tend to be smaller in the denser parts of the municipality. These include parts of the city dating back to the 19th century and earlier where gentrification is potentially an important issue.

2.3. House prices

Fig. 2 documents the development of house prices in the period 1997–2015 by presenting hedonic price indexes for the seven main areas in the Amsterdam municipality shown on the map of Fig. 1. Nominal house prices have increased substantially in the time window we study throughout the city, but there appears to be a dichotomy. On the one had there is the old city centre and the areas West, South and East that surround it south of the river IJ where prices increased by a factor 2.5 or more. On the other hand there are the remoter suburbs New-West and Southeast, where price increases were more moderate. The area north of the IJ is also lagging behind the first group, but less so than New-West and Southeast.

Guerrieri et al. (2013) have argued that gentrification in U.S. cities extends existing high income areas following a positive economic shock. Since house prices in the existing areas were already high, this means that price increases are especially large in surrounding areas where house prices were initially at a lower level. Fig. 3 shows the initial price on the horizontal axis and the price increase on the vertical one. The dichotomy between the four core areas and the three remoter ones is clearly recognizable. And although the negative correlation between price increase and initial price is not observed for all the seven areas in the municipality of Amsterdam, within the subset of core areas price increases were lower in the Center and South, where incomes and house price were already high, than in the areas gentrifying over the study period, the West and East. This suggests that something like American style gentrification was going on in the central part of the Amsterdam municipality.

The dichotomy between the central part of the Amsterdam

[5] See Koster & Rouwendal (2017).

[6] This number refers to transactions in the period 1997-2015. We didn't use the transaction in the years 1995 and 1996 in order to be able to use the lagged shares of rental housing that were available to us from 1995. Note also that observations in wards with (almost) only owner-occupied or rental houses were dropped.

[7] See Figure 4.

[8] See, for instance, Rouwendal & Van Duijn, (2017).

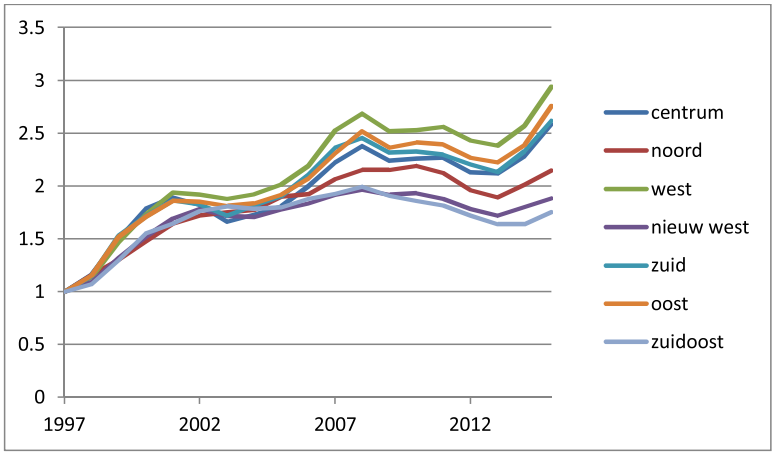

Fig. 2. Development of hedonic house price index by 'stadsdeel'. *Source:* own computations based on NVM data .

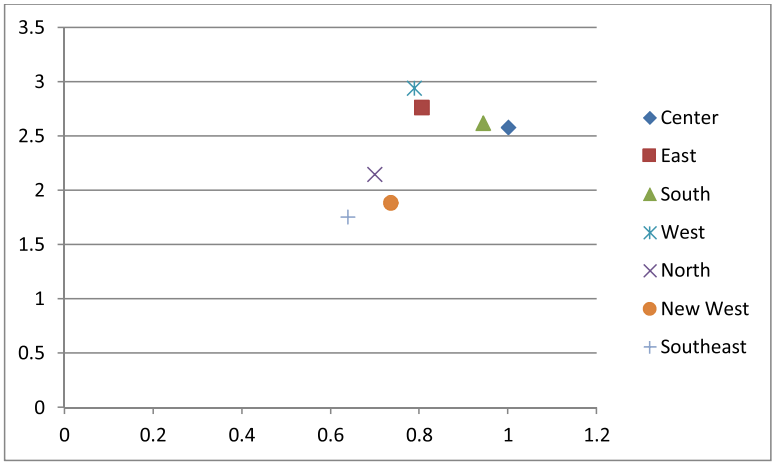

Fig. 3. Price increase by 'stadsdeel' versus initial price. *Source:* own computations based on NVM data.

municipality and the remoter parts North, New-West and Southeast is known by all inhabitants who indicate the former as the area 'within the ringroad' – the A10 that roughly coincides with the border of this area below the IJ lake – widely regarded as too expensive for ordinary people. Fig. 3 confirms this folk wisdom and suggests that gentrification may differ in importance in both parts of the city.

2.4. Rent control and the stock of rental housing

During WWII rents in the Netherlands were frozen and rent control has been kept in place ever since. The rent control does not only refer to the properties of the housing associations – to which we refer as social housing - but also most the stock of rental housing owned by private parties, the exception being a small high quality segment. We will refer to the rent controlled private properties as private rental housing.

In the first half of the 20th century it was quite common for wealthier people in the Netherlands to own one or a few houses that were rented out. After the introduction of rent control the value of such rental housing as an asset plummeted. Renters had a strongly protected position and could not be forced to leave, which implied that transfer to the owner-occupied sector was difficult and occurred only gradually. Even today a sizable part of the Amsterdam housing stock is private rental. Since no construction of such housing occurred after 1945, it mainly consists of older housing. In contrast, the stock of social rental housing increased considerably in the postwar decades including in older parts of the city through brownfield development, demolition of private rental housing – often in bad condition - followed by new construction of social rental housing, and renovation.

As mentioned in the introduction, generic subsidies on the construction of social housing were abandoned in the early 1990 s. This was not intended to stop the construction of social housing altogether. The housing associations had been able to accumulate a non-negligible amount of equity in earlier decades.[9] Moreover, the value of social housing that remained after its supposed maximum lifespan of 50 years was usually considerable, especially in the big cities where land prices are high. Although – unsurprisingly – the construction of social housing decreased substantially after the subsidies were abolished, housing associations remained active in the construction of such housing in Amsterdam, often aided by the local government through low land prices.

In the course of the 1990 s it was realized that allowing housing associations to sell part of their stock could help to satisfy the rising demand for owner-occupied housing. Moreover, this would provide an additional opportunity for the associations to free part of their wealth – that was mainly incorporated in the housing they owned - and invest it in newer social housing which could help them to better serve the needs

[9] Subsidies on construction were computed to be equal to the gap between costs and discounted revenues based on the calculation of a 'dynamic cost' and paid in the course of their exploitation of the houses, which gave the government the opportunity to adjust the necessary (for breaking even) subsidy when exploitation conditions changed over time. Contrary to what the computations assumed, even if the house could no longer be used, the value of the land underneath it could be considerable in cities like Amsterdam.

of their target groups.[10] These ideas were incorporated in a new law on the stimulation of homeownership[11] and a government white paper entitled 'What people wish, where people live' (in Dutch: 'Mensen, Wensen, Wonen').[12] The target was to sell 25,000 social houses per year in the whole country.[13] The sale could take place against conditions that were attractive to the seller: a sales price of 90% of the estimated market price was regarded as feasible, but 80% of that price when selling to new occupiers and even 70% when selling to residents was considered as allowed.[14]

Already in 1998, in anticipation of these developments, the municipality of Amsterdam made a covenant with the local housing associations that to sell some 28,575 houses by 2010. This would increase the share of owner-occupied housing to 35%. A second covenant was reached in 2008, referring to the sale of an additional 12,000 houses by 2016. Although these figures were not completely realized, the covenants contributed substantially to the change in the homeownership rate that has occurred since the early 1990 s. New construction in existing urban areas (mainly in-fills), predominantly owner-occupied, was the second driving force.

The maps in Fig. 4 show that there was an increase in the share of owned houses between 1995 and 2015 all over Amsterdam. This conclusion is confirmed by Fig. 5 that shows the development of the shares of the three tenure types in our data set (the 203 wards spread over the Amsterdam municipality) in the period considered. In the period 1995–2015 the share of social rental housing decreased from 45% to 38%, while the share of private rental housing decreased from 40% to 32%. While in the beginning of the period we study homeownership was mainly concentrated in some older parts of the city – e.g. the canal houses which have always been private property – and was mainly luxury housing, at its end homeownership was common and referred to all kinds of housing in many parts of the city. A major change in the Amsterdam housing market had taken place.

2.5. Housing construction

As noted, the increase in the share of owner-occupied housing is not only the result of the sale of existing rental housing, but also of construction and demolition. Over the 20 year period 1994–2014 > 40,000 houses, or approximately 10% were added to the existing stock.[15] The additions were not solely owner-occupied housing. As a rule the municipal government still requires at least 30% social rental housing in new construction projects, which is lower than the share in the existing stock. Much of the construction was concentrated in redevelopment areas like the Java-Island, close to the central station, and IJburg a newly developed area consisting of newly created islands in the IJ-lake to the east of the city center. However, in all parts of the city ('Stadsdelen') the housing stock increased every year.

Our data do not directly inform us about demolitions and new construction, but we know the total housing stock in each year of the period we study. Fig. 6 maps the difference between the number of houses per ward in 2015 and 1995 as a percentage of the 2015 stock. The figure confirms that construction of new housing occurred everywhere in the city. It may be noted that the change in the stock provides an underestimate of new construction, because new houses may replace demolished older housing.

2.6. Housing associations and the sale of social housing

Since the early 1990 s the position of the housing associations has been vulnerable. They own a large part of the housing stock and are expected to use their wealth in the public interest, but they are outside the public sector. Politicians do not have direct control over them, but they determine the increase in the regulated rents of social housing each year and expect the social housing associations to do their bidding. However, policy makers themselves have not always been clear and consistent in formulating what that is. Depending on the political colour and circumstances, entrepreneurship and social service have been emphasized. The lack of subsidies made it at least clear that financial control and professionalization were important issues. This has probably contributed to a large number of mergers which increased the size of the average housing association in the Netherlands considerably, although there is no evidence that the larger scale has contributed to efficiency (van den Berge, Buitelaar, and Weterings, 2013; Veenstra et al., 2017). The presence of a large amount of wealth in many of the associations, in combination with the absence of clear targets and proper checks and balances[16] left the possibility of associations becoming engaged in risky, and in some cases deviant, behaviour.

Currently 8 housing associations are active in Amsterdam. Of these, two small ones are specialized in student housing and housing with care.[17] The other six own at least 20,000 houses each, and the largest of these, twice that number. In total the housing associations own almost 193,000 houses, or 45% of the total Amsterdam housing stock in 2013.[18]

Fig. 7 shows the development of the sale of social rental housing over time. The figure reveals a substantial amount of temporal variation, partly in response to the recession of 2007 and the years that followed. Although not shown in the Figure, there is also a lot of variation in the sales by housing association over time. Over the whole period considered almost 12% of the total stock of social rental housing was sold to private persons, with sales distributed over all the areas of Amsterdam.

Earlier in this paper we emphasized that any positive impact of the changing share of owner-occupied housing on the local (neighbourhood) housing price is probably related to changing demographic composition. It is therefore important to notice that social rental housing could be sold to current tenants at a discount. Selling to current tenants happened in approximately 10% of the cases, in most cases without a discount.[19] According to Breure (2009) 30% of the social rental houses sold by housing associations were bought by persons already living in its neighbourhood.[20] Breure (2009) reports that 10% of the social rental houses sold in 2004 were sold again before 2008, often at considerably higher prices. This does not seem to be a surprisingly high number and house prices were rapidly increasing throughout Amsterdam in that period.[21]

[10] At the time house prices were rapidly increasing and this suggested that housing associations could use their wealth as a 'revolving fund' were the capital gains associated with the sale of older housing provided the means to construct new houses.

[11] The law Bevordering Eigen WoningBezit (WEB) passed the government in 2000. See http://wetten.overheid.nl/BWBR0011919/2017-01-01.

[12] Ministry of Housing (2001). One of the first chapters is entitled: 'From housing to living.'

[13] Realizations were much lower: 14,000-16,000 house were sold annually.

[14] See Aalbers (2004) for further discussion.

[15] OIS (2017).

[16] The wealth of housing associations originates from rental revenues of their own housing stock. The housing associations have no shareholders or other owners of their capital. There is no independent public authority overseeing these organizations.

[17] We have no information about the sales of one of these associations.

[18] Note that this differs from Figure 5. The reason is that the Figure refers to the 203 wards we use in the analysis below, not to the total housing stock.

[19] Information provided by AFWC.

[20] Breure (2009) also reports that in particular areas, Tuindorp-Oostzaan and Amsterdam-Noord, the majority of the houses sold by the associations was bought by current occupiers. She also reports that in these areas incomes, educations levels and the number of children have increased, possibly because the sale of houses induced households that would otherwise have moved to other areas to stay.

[21] Note also that house prices were still increasing in this period.

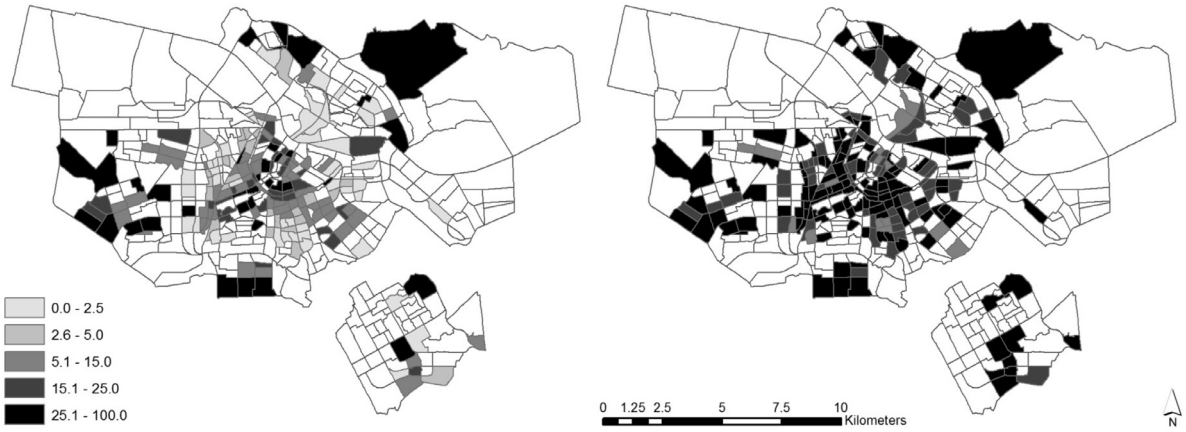

Fig. 4. Maps of the share of owned houses for 1995 (left) and 2015 (right) in the Amsterdam neighbourhoods included in our analysis (i.e. the unshaded neighbourhoods are not included in our data).

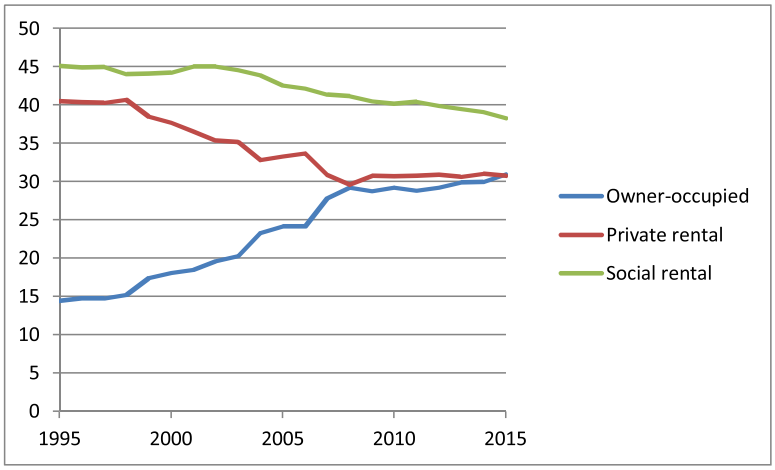

Fig. 5. Changes in the shares of tenure types 1995–2015.

Fig. 6. Share of housing constructed since 1995 in the 2015 stock.

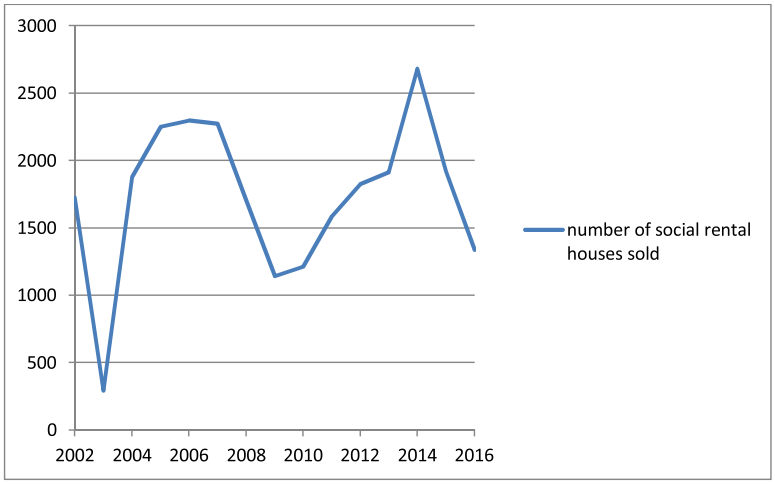

Fig. 7. Sale of social rental housing in Amsterdam 1998–2016. Note: the number indicated for 2002 refers in fact to the total number of houses sold in the period 1998–2002.

2.7. Allocation of rental housing

Housing associations were founded to take care of the housing needs of the poor. This remained their target group in the postwar years when their housing stock expanded considerably.[22] With a total share of more than 30% in the Amsterdam housing stock and an initially even larger share of cheap private rental housing, it was of course impossible that only the poorest people lived in rent-controlled housing. The stock of regulated rental housing in Amsterdam even today is large enough to house all households belonging to the share of low income households according to any reasonable definition. Indeed, one of the reasons for stimulating the sale of social rental housing was the observation that many households occupying this type of housing had a medium or high income, while at the same time there were many low-income households on the waiting lists.

The underlying issue is that household income can be checked at the time tenants move in, but that they cannot be forced to move out afterwards if the growth in their incomes pushes them out of the target group for social rental housing. In fact, until the 1980 s there even was no enforced policy of restricting entry to social housing to low-income households. Such households were prioritized, but social-democrats often thought that in principle anyone could be in social housing. However, since the early 1990 s more efforts were made to ensure that only lower income households entered vacant social housing, the main argument being that the subsidies involved were meant to help this group. The stricter enforcement of allocation rules was further stimulated by pressure from the European Union[23] and the desire to limit tax expenditure on housing allowances.[24] Currently 80% of the social rental housing that becomes vacant must be allocated to households in the target group, households with an income below € 36,135[25] while an additional 10% must be allocated to households with an annual income at most equal to € 40,349. .[26].

Once they have gained access to social housing, households can stay as long as they want. The low controlled rent makes moving towards owner-occupied housing less attractive, even if a substantial increase in quality can be realized. The limited availability of owner-occupied housing in Amsterdam reinforced this effect. The result is low mobility from social rental to owner-occupied housing and a large share of social housing that is occupied by households no longer belonging to the target group. In this situation, the sale of social rental housing must be expected to help increasing the supply of owner-occupied housing, while it liquidates wealth of the housing associations that can be used to make available other social housing for low-income households on the waiting lists.

It is less clear how the allocation in the private rental sector works. Landlords try to select households with stable incomes who can be expected to pay the rents and keep the house in good shape. This makes it less likely that people with unstable employment or family situations are in this part of the market. On the other hand, the old age, in general low quality and poor incentives for maintenance make it unlikely that this part of the housing stock is very attractive for medium or high income households except for its low rent. Note, however, that the latter is a significant issue in the Amsterdam housing market where house prices are very high by Dutch standards.

2.8. Literature

The first study on the sale of social rental housing on house prices in the Netherlands was carried out by Van de Minne, Francke, and Conijn (2012) who focused on the impact of the possibility to sell social rental housing below the market price on the development of the price index for owner-occupied housing in the Netherlands. Two years later Schilder et al. (2014) looked at the impact of the sale of social rental housing on the transaction prices of nearby houses. They estimated an average decrease of 2% of the transaction prices over the period 2005–2013 for the Netherlands as a whole. When focusing on Amsterdam, they found that the local price discount was limited: social housing was sold on average only 5.7% below the estimated market value. Nevertheless, they found a statistically significant effect of − 1.6% of the sale of social housing on transaction prices in this city. The study did not control for the simultaneous sale of private rental housing.

Gentrification in Amsterdam has recently been studied by

[22] In 2017 the target group for social rental housing were households with an annual income of at most ϵ 36,136.

[23] The argument is that housing association are subsidized by the government, which distorts the market on which they are active. EU rules only allow this if the subsidies are targeted at a clearly defined group.

[24] Low income households can apply for a housing allowance if the rent they pay exceeds a normative share of their income. The subsidy covers part of the difference between the actual and normative rent. Without strict allocation rules it stimulates housing consumption and allows housing associations to assign relatively expensive houses to low income households. About 25% of the inhabitants of rent-controlled housing receive such an allowance.

[25] This is almost equal to the median income of Dutch households (see S. Groot, Mohlmann, & Lejour, 2016).

[26] These figures refer to 2017.

Hochstenbach et al. (2015) who found relatively small effects. More specifically, they report that a comparison of the income levels of incoming and leaving households does not provide evidence of direct economic displacement. Although they note that the incoming households were often upwardly mobile, Boterman and van Gent (2014) focused on tenure conversion and concluded that it caused social upgrading (the status of the in-migrants being higher than that of the older inhabitants) and facilitated demographic and ethnic transformations of neighborhoods. However, they found that the effects differed substantially over neighborhoods and ethnic groups. For example, Turkish migrants often bought the formerly rental housing, whereas Surinamese people appeared not to be interested in homeownership. The authors could not distinguish between social and private rental housing.

3. Data

The data have already been introduced in the previous section. For the regression results that are presented in the next section, the NVM data are the basic source. For every transaction NVM members report the transaction price and a large number of characteristics including floor area, apartment type, number of rooms, parking facilities.[27]

The number of observations fluctuates over time. In 1997 > 2000 transactions were registered, but in 1999 barely 1200. After that the number increased continuously to more than 5,500 in 2007. The next trough was reached in 2013 with a little less than 4200 transactions registered, while in the last two years for which we have observations more than 6000 transactions were observed. In each year some 80% of the transactions refer to houses in the central part of the municipality with West and South each good for a quarter of the total number of transactions and the remaining 30% shared more or less equally between Center and East. Of the three peripheral areas, New-West is the most important one as far as housing sales are concerned with some 10% of the total number of transactions but its relative position fell somewhat over time. The share of transactions referring to North increased slightly over time while that of Southeast decreased.

Fig. 4 above showed the development of the tenure shares in the wards we consider. There is a wide variation in the shares of the various tenure types per ward. The standard deviation of the share of owner-occupied housing is 16.7 in 1995 and decreases gradually to 13.6 in 2015. The maximum is stable at 80%, while the minimum is 0 until 2005, and then increases to 7%. The variance in the share of social housing equals 30.0 in 1995 and decreases to 22.5 in 2015. Until 1999 this his share was as high as 100% and as low as 2.6%. Private rental housing shows a similar picture with a variance decreasing from 27.0 to 17.8 and before 1998 values that ranging between 0 and 100. In 2015 the highest share of social housing is still 90%, and that of private rental housing 74%.

To put the analysis that follows into perspective, it is useful to provide some information about the inhabitants of houses in the 1990 s, before the sale of rental housing started. We use information from the national housing survey (in Dutch: *Woningbehoefteonderzoek*) from 1993. The survey covered some1900 Amsterdam households. Of these, 236 were in owner-occupied housing, 931 in social rental housing and 488 in private rental housing. The others rented a house from the municipality or government institutions or were subtenants.

Almost 50% of the inhabitants of private rental housing were singles. Pairs without children at home were the dominant category among owner-occupiers (44%). Social rental housing was halfway between both. Annual household income is twice as large among owner-occupiers as among renters. Those in private rental housing had on average a 10% higher income than those in social housing.

There was a substantial difference in the country of origin of the various tenure types: 89% of the owner-occupiers and 84% of the private renters were born in the Netherlands, but only 68% of the social renters. Especially Moroccans and those born in the former Caribbean Dutch colonies were overrepresented in social housing.

Of the rental houses – of either subtype – 90% were apartments, but apartments were only 55% of the owner-occupied houses. The private rental stock was the oldest with75% dating to before WWII compared to 50% of the owner-occupied stock and only 30% of the social rental housing stock. Owner-occupied housing had on average 4 rooms, private rental housing 3, and social rental housing 3.22. Finally, 82% of owner-occupied housing had central heating, while for social and private rental housing this figure was respectively 65% and 43%.

Summarizing, it appears that the special position of social rental housing is reflected in the ethnic composition of its inhabitants that differs substantially from the other tenure types. The older age of private rental housing and the lack of incentives for modernization associated with the rent control imposed since WWII probably makes it less attractive. Gentrification through changes in the demographic composition of neighbourhoods or upgrading of dilapidated housing appear to be potentially relevant possibilities, but it seems difficult to make any specific prediction based on the information just presented.

4. Method and results

4.1. The specification

To investigate the impact of the changing shares of rental housing per ward, we estimate a hedonic price equation. Our first specification relates the natural logarithm of the transaction price of a house to its structural characteristics, an area fixed effect, a year fixed effect and the change in the share of rental housing in the previous year. The area fixed effects refer to the wards, the smallest geographical unit about which we have information. The year fixed effects are specific for each area (Stadsdeel, see Fig. 1) in order to take into account the local differences in house price development that were documented in the previous section (see Fig. 2). Mathematically, the basic model is formulated as follows:

$$Log\,(Price_i) = \alpha_{w(i)} + \beta X_i + \delta_{t(i)*s(i)} + \gamma \Delta RENT_{w(i),t(i)} + \varepsilon_i \quad (1)$$

The equation states that the price of house i that is located in ward $w(i)$ and area $s(i)$ and sold in year $t(i)$ equals the sum of a ward-specific intercept $\alpha_{w(i)}$, the impact of the structural characteristics βX_i and the general time trend $\delta_{t(i)*s(i)}$. The variable of interest is the change in the share of rental housing $\Delta RENT_{w(i),\,t}$ in the ward in which the house is located and the year in which the house is sold. Finally there is an error term ε_i. The equation thus relates the *level* of the transaction price to the *change* in the share of rental housing. The idea is that an increase in the local supply of owner-occupied housing due to the sale of rental housing causes a temporary change in the price of owner-occupied housing. The familiar forces of supply and demand would suggest a positive coefficient γ_1, but gentrification effects could reverse this mechanism. Note that the ward-specific fixed effects ensure that the coefficient $\gamma_1$is determined only by variation in the changes in the share of rental housing over time within the wards.

One may think that not all effects of the sale of rental housing are realized immediately. For that reason we have also estimated equations in which the change in the share of rental housing is lagged. If the sale of rental housing has a gentrifying impact, it may even be possible that the sale of rental housing has a long-lasting impact on house prices in the ward. One may attempt to measure this effect by including (the level of) the share of rental housing into the equation:

$$Log\,(Price_i) = \alpha_{w(i)} + \beta X_i + \delta_{t(i)*s(i)} + \varphi RENT_{w(i),t(i)} + \varepsilon_i \quad (2)$$

This equation states that a change in the share of rental housing has a permanent impact on the level of house prices in the ward. Although this is somewhat extreme when taken literally, it may be noted that our

[27] A full list of characteristics used in the regressions with descriptive statistics is available upon request.

Table 1
Regression results for changes in the share of rental housing by ward.

Variables	(1)	(2)	(3)	(4)	(5)
$\Delta RENT_{w,\,t}$ (%)	−0.00135*** (0.00040)		−0.00082 (0.00063)		−0.00258*** (0.00065)
$\Delta RENT_{w,t-1}$ (%)		−0.000947** (0.00047)	−0.00054 (0.00068)		
$RENT_{w,\,t}$				−0.00193*** (0.00061)	
$RENT_{w,t\,-1}$					−0.00185** (0.00062)
Structural characteristics, ward dummies and year*stadsdeel dummies	YES	YES	YES	YES	YES
Observations	72,178	72,178	72,178	72,178	72,178
R-squared	0.9202	0.9202	0.9202	0.9203	0.9203

Robust standard errors clustered at the ward level are reported.

Table 2
Regression results for changes in the share of social and private rental housing by ward.

Variables	(1)	(2)	(3)	(4)	(5)
$\Delta SOC\,RENT_{w,\,t}$ (%)	−0.00165*** (0.00052)		−0.001060* (0.00057)		−0.00215*** (0.00062)
$\Delta PRIV\,RENT_{w,\,t}$ (%)	−0.00088** (0.00044)		−0.00107* (0.00057)		−0.00255*** 0.00063
$\Delta SOC\ RENT_{w,t-1}$		−0.00115** (0.00050)	−0.00061 (0.00063)		
$\Delta PRIV\ RENT_{w,t\ t-1}$		−0.00018 (0.00041)	0.00035 (0.00054)		
$SOC\,RENT_{w,\,t\,to\,t}$				−0.00074*** (0.00047)	
$PRIV\,RENT_{w,\,t\,to\,t}$				−0.000251*** (0.00067)	
$SOC\ RENT_{w,t\ to\ t-1}$					−0.00055 (0.00047)
$PRIV\ RENT_{w,t\ to\ t-1}$					−0.00255*** (0.00069)
Structural characteristics, ward dummies and year*stadsdeel dummies	YES	YES	YES	YES	YES
Observations	72,178	72,178	72,178	72,178	72,178
R-squared	0.9202	0.9202	0.9202	0.9205	0.9205

Robust standard errors clustered at the ward level are reported.

data cover a period of only 20 years and gentrification was an issue throughout that period.

It may of course also be argued that short- and long run effects may differ and that it could be useful to distinguish the two by including the recent change as well as a the lagged level of the share of rental housing. For instance, it may be argued that in the short run the forces of supply and demand may dominate, whereas in the longer run the gentrification effect is more important. The simplest of such a specification would be:

$$Log\,(Price_i) = \alpha_{w(i)} + \beta X_i + \delta_{t(i)*s(i)} + \gamma \Delta RENT_{w(i),t(i)} + \varphi RENT_{w(i),t(i)-1} + \varepsilon_i \quad (3)$$

In this equation the short run is identified with a single period, while the long run effect is present from the second year onwards.

4.2. Basic results

Table 1 presents estimation results for the basic specification. The first thing to observe is that all estimated coefficients are negative, indicating that the sale of rental housing tends to increase prices. Gentrification effects thus seem to dominate those of increased supply of owner-occupied housing. Column 1 shows that a decrease in the share of rental housing has an immediate positive impact on the price of owner-occupied housing in the ward. The effect is significant at less than 1%. In column 2 we use the one year lagged change in the share of rental housing. The coefficient is again negative and significant, but smaller. In column 3 we use the changes in the share of rental housing in the current and previous year and find two negative coefficients that are both insignificant. In column 4 we use the level of the share of rental housing in the current period as explanatory variable. As explained above, the estimated coefficient indicates a permanent effect associated with the sale of rental housing. The coefficient is again negative and larger in absolute value than the ones estimated earlier. Finally, in column 5 we use the change in the share of rental housing in the current year as well as the one-year lagged level of this share to be able to distinguish short and long-run effects. For both variables we find a significant negative coefficient, suggesting that gentrification effects are present in the short run as well as in the long run. We have also experimented with more lags, but such specifications did not change the picture that emerges from Table 1. Summarizing, it may be concluded that the basic results of Table 3 suggests that the sale of rental housing made the wards concerned more attractive for owner occupiers, both in the short run and in the long run.

4.3. Distinguishing between social and private rental housing

We noted above that the distinction between social and private rental housing is probably relevant for gentrification. While both are rent controlled, housing associations have a social function and – at least in principle – the obligation to be available for all low-income households. For private rental housing this is less clear and therefore one may expect that gentrification effects are especially present when the share of social housing decreases.

Table 2 reports the results of regressions in which the two types of rental housing have been distinguished. The first column confirms our conjecture that the gentrifying effects of the sale of social rental housing exceed those of private rental housing and also more significant. If we look at the one-year lagged effects, we find that only the coefficient for social rental housing is significant, but smaller than in the first

Table 3
Distinction between center and periphery.

Variables	(1)	(2)	(3)	(4)	(5)
CENTRAL AREA					
$\Delta SOC\ RENT_{w,\ t}$ (%)	−0.00251*** (0.00090)		−0.00134* (0.00106)		−0.00339*** (0.00105)
$\Delta PRIV\ RENT_{w,\ t}$ (%)	0.00112 (0.00068)		−0.00076 (0.00083)		−0.00352*** 0.00079
$\Delta SOC\ RENT_{w,t-1}$		−0.00184** (0.00092)	−0.00119 (0.00120)		
$\Delta PRIV\ RENT_{w,t\ t-1}$		−0.00068 (0.00063)	−0.00030 (0.00054)		
$SOC\ RENT_{w,\ t\ to\ t}$				−0.00134* (0.00071)	
$PRIV\ RENT_{w,\ t\ to\ t}$				−0.00359*** (0.00077)	
$SOC\ RENT_{w,t\ to\ t-1}$					−0.00115 (0.00073)
$PRIV\ RENT_{w,t\ to\ t-1}$					−0.00363*** (0.00078)
PERIPHERAL AREA					
$\Delta SOC\ RENT_{w,\ t}$ (%)	−0.00102** (0.00048)		−0.00111** (0.00054)		−0.00137** (0.00056)
$\Delta PRIV\ RENT_{w,\ t}$ (%)	−0.00061 (0.00045)		−0.00160** (0.00073)		−0.00050 0.00050
$\Delta SOC\ RENT_{w,t-1}$		−0.00047 (0.00042)	−0.00017 (0.00054)		
$\Delta PRIV\ RENT_{w,t\ t-1}$		−0.00052 (0.00029)	0.00129** (0.00050)		
$SOC\ RENT_{w,\ t\ to\ t}$				0.00067 (0.00047)	
$PRIV\ RENT_{w,\ t\ to\ t}$				0.00016 (0.00056)	
$SOC\ RENT_{w,t\ to\ t-1}$					−0.00085 (0.00049)
$PRIV\ RENT_{w,t\ to\ t-1}$					−0.00020 (0.00060)
Structural characteristics, ward dummies and year*stadsdeel dummies	YES	YES	YES	YES	YES
Observations	72,178	72,178	72,178	72,178	72,178
R-squared	0.9202	0.9202	0.9202	0.9206	0.9206

regression. If both the current and lagged changes in the share of rental housing are included, we find that only the current change is weakly significant. If we turn to the regressions in levels, the picture changes in that the share of private rental housing now has a much larger (more than three times) coefficient than the share of social housing. Both are strongly significant. Column (5) suggests that the sale of social rental housing only has a temporary effect, whereas that of private rental housing has a permanent effect that is fully realized immediately.

4.4. Centre and periphery

In Section 2 it was suggested that the distinction between the central area where house prices were initially highest or increased most and the remoter parts could be important. We will now consider if there are differences in the impact of the sale of rental housing between these two parts of the city.

The results reported in Table 3 confirm the presence of these differences. If we only allow for effects in the current year, the change in the share of social housing has a positive effect on house prices which is twice as large in the centre than in the periphery. There is no effect of changes in the share of private rental housing. If we only allow for one-year lagged effects, there is only an effect of social housing in the centre. If effects of the change in the current as well as the previous year are allowed for, we find comparable effects of changes in the share of social rental housing in the centre and the periphery, but only in the current period. For private rental housing we do not find any effect in the centre, while in the periphery there is a positive effect of the sale of private housing in the current period and a negative one of the same order of magnitude in the next one.

Again the picture changes substantially if we allow for permanent effects. In column (4) we find significant gentrifying effects of the sale of social as well as private housing, but the impact of the latter is much larger. Column (5) suggests that the sale of social housing only has a temporary effect that is larger in the core than in the periphery. The sale of private rental housing has a permanent impact that is realized immediately in the core, but no significant effect in the periphery.

4.5. Controlling for changes in the total stock

A concern one may still have with the results presented in the previous subsections is that changes in the stock of housing may partly explain it. We have seen that new construction in the period we considered was predominantly owner-occupied. It therefore tends to drive down the share of rental housing, and especially that of private rental housing. New housing is, moreover, of better quality and could attract other households to the ward that could be responsible for a gentrification effect.

To deal with this issue, we have added the gross change in the stock – expressed as a percentage of the initial stock – as an additional control variable. Since we have no direct information on new construction and demolitions, this is the best we can do. Table 4 presents the results. Increases in the stock do not appear to have any effect on house prices in the central part of the municipality and have a positive and relatively large impact on house prices in the peripheral part. Most of the results reached earlier do not change by inclusion of the new control variable. The only exception is that the sale of social housing in the peripheral part now appears to have a permanent negative effect on house prices.

4.6. Endogeneity

A concern one might have with the regressions reported thus far is that landlords do not choose the houses they sell randomly. Selling rental housing may be easier in city quarters that are already gentrifying. If more houses are selected for sale in these areas, and the gentrification causes prices to increase there more than expected, the result will be a correlation between the error term in our estimating equation and the change in the share of rental housing. The result is endogeneity of that variable. Although our inclusion of separate year fixed effects for seven areas (Stadsdelen) may help to mitigate this problem, we cannot

Table 4
Adding the change in housing stock as a control variable.

Variables	(1)	(2)	(3)	(4)	(5)
CENTRAL PART					
$\Delta SOC\ RENT_{w,\ t}$ (%)	−0.00254*** (0.00091)		−0.00137 (0.00107)		−0.00336*** (0.00106)
$\Delta PRIV\ RENT_{w,\ t}$ (%)	0. (0.00068)		−0.00076 (0.00083)		−0.00352*** 0.00078
$\Delta SOC\ RENT_{w,t-1}$		−0.00184** (0.00092)	−0.00118 (0.00121)		
$\Delta PRIV\ RENT_{w,t\ t-1}$		−0.00068 (0.00063)	−0.00030 (0.00082)		
$SOC\ RENT_{w,\ t\ to\ t}$				−0.00134* (0.00071)	
$PRIV\ RENT_{w,\ t\ to\ t}$				−0.00359*** (0.00076)	
$SOC\ RENT_{w,t\ to\ t-1}$					−0.00115 (0.00073)
$PRIV\ RENT_{w,t\ to\ t-1}$					−0.00363*** (0.00078)
$DSTOCK_{W,\ T}$	−0.00478 (0.00491)	−0.00385 (0.00502)	−0.00424 (0.00492)	−0.00362 (0.00355)	−0.00512 (0.00367)
PERIPHERAL PART					
$\Delta SOC\ RENT_{w,\ t}$ (%)	−0.00125*** (0.00048)		−0.00125** (0.00054)		−0.00070 (0.00045)
$\Delta PRIV\ RENT_{w,\ t}$ (%)	−0.00073* (0.00043)		−0.00164** (0.00071)		−0.00061 0.00049
$\Delta SOC\ RENT_{w,t-1}$		−0.00061 (0.00041)	−0.00007 (0.00053)		
$\Delta PRIV\ RENT_{w,t\ t-1}$		−0.00052 (0.00029)	0.00121** (0.00051)		
$SOC\ RENT_{w,\ t\ to\ t}$				0.00074 (0.00047)	
$PRIV\ RENT_{w,\ t\ to\ t}$				0.00018 (0.00056)	
$SOC\ RENT_{w,t\ to\ t-1}$					0.00097** (0.00047)
$PRIV\ RENT_{w,t\ to\ t-1}$					−0.00024 (0.00060)
$DSTOCK_{w,\ t}$	0.0471*** (0.0159)	0.0459*** (0.0166)	0.0464*** (0.0175)	0.0457*** (0.0120)	0.0524*** (0.0146)
Structural characteristics, ward dummies and year*stadsdeel dummies	YES	YES	YES	YES	YES
Observations	72,178	72,178	72,178	72,178	72,178
R-squared	0.9202	0.9202	0.9202	0.9206	0.9207

Table 5
Instrumental variable (2SLS) regression results for changes in the share of rental housing by ward.

Variables	(1) Central	(2) Central	(3) Central	(4) Central	(5) Periph.	(6) Periph.
$\Delta SOCIAL\ RENT_{w,\ t}$ (%)	−0.00121 (0.00601)	−0.00916** (0.00419)	0.00033 (0.00654)	−0.01246*** (0.00445)	0.049 (0.40)	−0.0118 (0.0152)
$\Delta PRIV\ RENT_{w,\ t}$(%)	−0.00991 (0.00776)	0.00213 (0.00367)	−0.01003 (0.00662)	0.00037 (0.00344)	0.043 (0.36)	−0.0178 (0.0128)
$SOCIAL\ RENT_{w,t-1}$(%)	−0.00002 (0.0015)	−0.00246*** (0.00096)	0.00098 (0.00156)	−0.00268** (0.00108)	0.0102 (0.0781)	−0.00160 (0.00298)
$PRIV\ RENT_{w,t-1}$(%)	−0.00461*** (0.00123)	−0.00263*** (0.00102)	−0.00458*** (0.00101)	−0.00333*** (0.00100)	0.0100 (0.0848)	−0.00317 (0.00465)
$DSTOCK_{w,\ t}$(%)	−0.00022 (0.00669)	−0.01165** (0.00574)	−0.00029 (0.0070)	−0.01310** (0.00588)	−0.0751 (0.89)	0.0595 (0.048)
Structural characteristics, ward dummies and year*stadsdeel dummies	YES	YES	YES	YES	YES	YES
Instrument	Bartik + prop	prop + prop	Bartik + prop	prop + prop	Bartik + prop	prop + prop
Levels instrumented	No	no	yes	yes	no	No
Observations	57,947	57,947	57,947	57,947	14,231	14,231
R^2	0.917	0.917	0.917	0.917	0.810	0.905

Robust standard errors clustered at the ward level are reported. First stage regressions are reported in the Appendix Table.

be sure that it is completely absent.

To address this issue, we have constructed instruments for the changes in the share of social and rental housing. We used information[28] about the number of houses owned by the various housing associations in small sets of contiguous wards (called *buurtcombinaties* in Dutch) and the annual total sales of social rental housing by these associations to construct an instrument *a la* Bartik (1991). That is, we compute the expected change in the share of social rental housing on the basis of the total sales of housing associations per year and the number of houses owned by each of these associations in the neighbourhood. Formally, if $S_{k,\ b}(t)$ is the housing stock owned by housing association k in area b, and $DS_k(t)$ is the number of houses sold by association k in year t, then the expected number of houses sold in area b is $EDS_{k,b} = (S_{k,b}(t)/\sum_{b'} S_{k,b'}(t))$. The expected total number of social rental houses sold in the area in year t equals $\sum_k EDS_{k,b}$ the sum of the expected sales per association over all associations. The instrument is this number divided over the total stock of housing in the area. The instrument thus has the same value for all wards belonging to the same *buurtcombinatie*. In Table 5 below we refer to this instrument as the Bartik instrument.

[28] Kindly provided by the Amsterdamse Federatie van Woningcorporaties (AFWC).

Computation of this instrument is only possible for social rental housing. For private rental housing we cannot make a subdivision on the basis of ownership. However, what we can do is compute the expected number of private rental houses that would have been sold in each ward if the observed total number of private rental houses sold in a given year would have been determined by giving each privately rented house the same probability of being sold. This appears to be the best we can do for this type of housing. Formally, if $DP_k(t)$ is the total number of private rental houses sold in the municipality in year t, the expected number of private rental houses sold in ward w equals $EDP_w(t) = (P_w(t)/\sum_w P_w(t))DP_k(t)$, where $P_w(t)$ is the stock of private rental housing in ward w in year t. The instrument is this umber, divided by the total stock of housing in the ward.

In Table 5 below we report IV estimates for specification (3), the preferred specification of our earlier exercises. We carried out separate regressions for the central and peripheral parts of the municipality and included the change in the housing stock as a control variable. Columns (1) and (2) refer to the central part and use the Bartik instrument and the proportional instrument, respectively, for the change in the share of social rental housing. In both cases we find a significant permanent gentrifying effect of the sale of private rental housing. Moreover, if we use the proportional instrument for the change in social housing we also find significant short and long run gentrifying effects of the sale of social housing and of new construction.

Columns (3) and (4) report estimates of a variant of this model in which we have also instrumented the level of the share of social and private housing. The reason for doing so is the possible concern that changes in the stocks can have short run effects on house prices with a lag of two periods. Although in earlier egressions we did not find much evidence for this, it was nevertheless thought useful to mitigate this concern by instrumenting the one period lagged share with the two period lagged share. The reported estimates show that the results do not change.

Columns (5) and (6) are similar to (1) and (2), but refer to the peripheral part of the municipality. We do not find any significant coefficient referring to changes or levels in the rental housing stock or to new construction. This does not change if we instrument for the levels (the results of these specification are not reported in Table 5).

5. Conclusion

In this paper we considered the impact of the sale of rental housing on local house prices in Amsterdam in the period 1995–2015. We documented a substantial shift in ownership rates over this period. In contrast with earlier work that looked for price decreases associated with the sale of social rental housing, we also considered the sale of private rental housing which appeared to be even more important in a quantitative sense.

The international literature suggests that the sale of rental housing may have gentrifying effects that boost local house prices. The specifications used in this study allowed us to distinguish between short-run and long run effects of potentially opposite signs and therefore placed us in a good position to look for both supply effects and gentrification. Viewed from the perspective of the earlier Dutch literature, that has repeatedly claimed to have found modest price-decreasing effects from the sale of social rental housing, it is perhaps somewhat surprising to conclude that we have been unable to find serious evidence of any depressing impact of the sale of rental housing on the transaction prices of owner-occupied housing in Amsterdam.

Inspection of the development of house prices in seven areas (*stadsdelen*) of the municipality revealed a qualitative difference between a central area, including the canal belt, and a peripheral area. Within the central area, the parts with the initially lowest price levels experienced the strongest increase in price as was observed by Gurrieri et al. (2013) for U.S. cities. In the peripheral area both the house price levels and the increases are smaller than in the central area.

Our main finding is robust evidence of a modest gentrifying impact of the sale of private rental housing in the central part of the municipality. That is, an increase in the supply of owner-ccupied housing of 15% of the total stock in a period of 20 years has been absorbed by the market without any serious indication of a depressing impact on the price level. Although substitution of tenures implies a simultaneous decrease in the supply of rental housing, the two should not be expected to compensate each other because of the limited overlap between the groups of renters and owner-occupiers. A main reason for the separation of both groups is that the maximum size of a mortgage loan depends on income, which makes owner-occupation in an expensive place like Amsterdam only possible for higher income households.

Our results suggest that the gentrifying effect has outweighed the effect of the increased supply and both were roughly of the same order of magnitude. Nevertheless, in the central part of the municipality we find robust evidence of a statistically significant net gentrification effect of the sale of private rental housing. Our IV estimation results suggest an elasticity of the housing price with respect to the share of private rental housing of around 0.1.

It seems probable that the positive net effect of selling private rental housing has to do with the long period of rent control that has been imposed on such housing and removed most of the incentives to modernize it, for instance by introducing central heating, or combining two small older apartments into a luxury modern one. Our estimates indicate quite strongly that the gentrifying effect is realized immediately after the sale of the rental housing.

We also found some indications of a gentrifying effect of increases in the housing stock in the peripheral areas of Amsterdam. Although the estimated coefficients lost significance after instrumenting the changes in both types of rental housing, it should be noted that our instruments did not work well for this part of the municipality.

Placed in the perspective of the international literature, it can be noted that the sale of rental housing in Amsterdam shows some similarities with the end of rent control in Cambridge (Ma) studied in Autor et al (2014). Like these authors we find a significant gentrification effect.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jhe.2018.07.002.

Appendix

Results of first stages of IV regressions

Table and column	*Endogenous var*	*Instrument*	*Estimate*	*Standard error*
Column 1	Δ % soc rental	Bartik for social	−1.835***	0.395
		prop for private	120.42***	31.56
	Δ % priv rental	Bartik for social	0.921*	0.51
		Prop for private	99.43**	45.66
Column 2	Δ % soc rental	prop for social	−59.06***	18.53
		prop for private	115.08***	31.10
	Δ % priv rental	prop for social	119.59***	24.61
		prop for private	105.48**	45.25
Column 3	Δ % soc rental	Bartik for social	−1.248***	0.325
		prop for private	71.58**	31.55
		$SOCIAL\ RENT_{w,t-2}(\%)$	−0.157***	0.022
		$PRIV\ RENT_{w,t-2}(\%)$	−0.0071	0.0060
	Δ % priv rental	Bartik for social	0.508	0.43
		prop for private	161.43***	45.19
		$SOCIAL\ RENT_{w,t-2}(\%)$	−0.00033	0.020
		$PRIV\ RENT_{w,t-2}(\%)$	−0.109***	0.019
	$SOCIAL\ RENT_{w,t-1}(\%)$	Bartik for social	−2.652***	0.376
		prop for private	176.47***	25.97
		$SOCIAL\ RENT_{w,t-2}(\%)$	0.798***	0.021
		$PRIV\ RENT_{w,t-2}(\%)$	0.020**	0.0096
	$PRIV\ RENT_{w,t-1}(\%)$	Bartik for social	1.569***	0.489
		prop for private	−187.53***	33.06
		$SOCIAL\ RENT_{w,t-2}(\%)$	0.0701***	0.025
		$PRIV\ RENT_{w,t-2}(\%)$	0.844***	0.025
Column 4	Δ % soc rental	prop for social	−62.11***	20.13
		prop for private	69.31**	31.33
		$SOCIAL\ RENT_{w,t-2}(\%)$	−0.163***	0.023
		$PRIV\ RENT_{w,t-2}(\%)$	−0.011	0.0061
	Δ % priv rental	prop for social	130.87	25.99
		prop for private	165.35***	44.74
		$SOCIAL\ RENT_{w,t-2}(\%)$	0.0113	0.020
		$PRIV\ RENT_{w,t-2}(\%)$	−0.104***	0.019
	$SOCIAL\ RENT_{w,t-1}(\%)$	prop for social	130.751***	23.46
		prop for private	175.57***	26.40
		$SOCIAL\ RENT_{w,t-2}(\%)$	0.797***	0.022
		$PRIV\ RENT_{w,t-2}(\%)$	0.0173*	0.0093
	$PRIV\ RENT_{w,t-1}(\%)$	prop for social	−90.70***	29.18
		prop for private	−189.46***	32.66
		$SOCIAL\ RENT_{w,t-2}(\%)$	0.0628**	0.026
		$PRIV\ RENT_{w,t-2}(\%)$	0.842***	0.025
Column 5	Δ % soc rental	Bartik for social	−0.806	1.252
		prop for private	435.46	268.04
	Δ % priv rental	Bartik for social	0.736	1.423
		Prop for private	−469.43	297.12
Column 6	Δ % soc rental	prop for social	−72.770	46.31
		prop for private	451.35	267.25
	Δ % priv rental	prop for social	17.806	62.64
		prop for private	−475.87	298.28

Only the estimation results for the instrument(s) are reported. All control variables have been included in the first stage regressions. Robust standard errors clustered at ward level are reported.

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